



# Vetronics Reference Architecture

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# Agenda



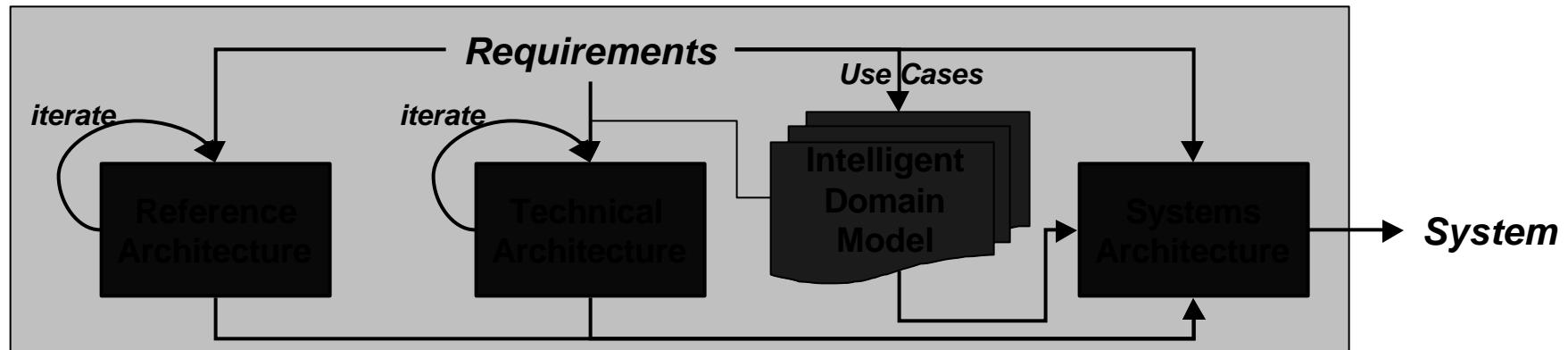
- Architecture Concepts/Overview
- VRA Objectives
- VRA Components
- Systems Reference Architecture
- Hardware Reference Architecture
- Software Reference Architecture



# Architecture Concepts/Overview



- Reference Architecture (RA)
  - ▶ Abstract view/organization of primary elements within the domain.
  - ▶ Serves as specific System Architecture development framework.
- Technical Architecture (TA)
  - ▶ Standards (hw, sw, mechanical, etc.) utilized as building blocks to construct systems.
- Intelligent Domain Model
  - ▶ Captures system intelligence such that computational processes can be allocated to system processing components (e.g. human, robotic, man in the loop)
- Systems Architecture (Cross product of RA, TA, and Intelligent Domain Model)
  - ▶ Defines interconnected systems components organized to represent the final manner in which the system will be constructed to include hw and sw.



*Need to focus on refining RA, TA, and Intelligent Domain Model to derive a common Vtronics architecture.*



## VRA Objectives



- The main objective of the VRA is to define a generic system architecture that can serve as a template for the development of new or upgraded Vetronics & Robotic systems
  - ▶ Reduce ground combat vehicle acquisition and support costs through:
    - ***Improved Commonality***
    - ***Increased Hardware Component Reuse***
    - ***Increased Software Component Reuse***
  - ▶ Utilizes Industry Supported Open Standards
  - ▶ Provides:
    - ***Fault Tolerance***
    - ***Redundancy***
    - ***Degraded Operation Modes***
  - ▶ Facilitates Upgradability through:
    - ***Standard Interfaces***
    - ***Technology Insertion***

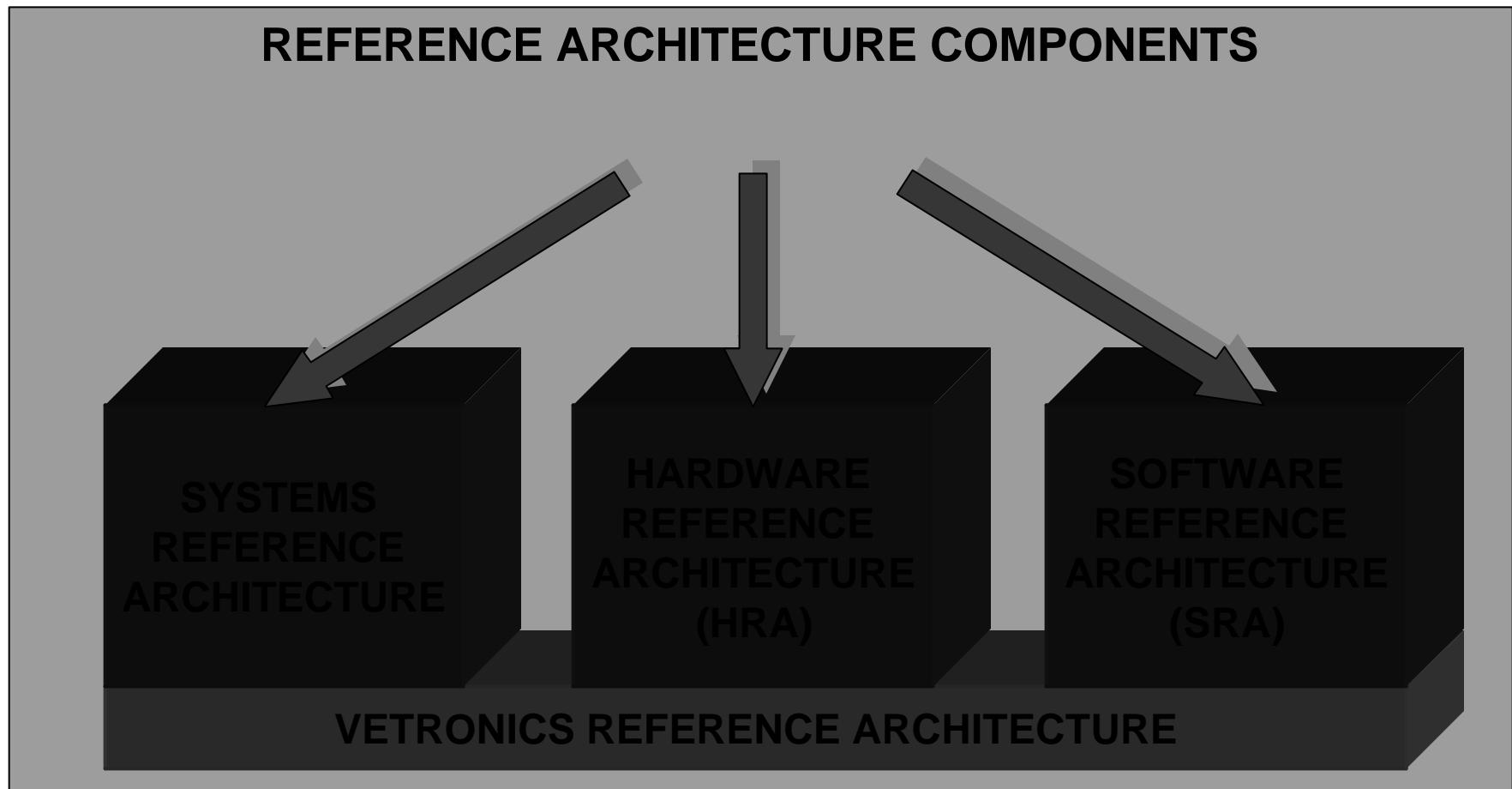
*The RA maximizes the use of industry supported open standards and promotes software reuse*



# Vetronics Reference Architecture Components



- The Vetronics Reference Architecture is characterized by three components:



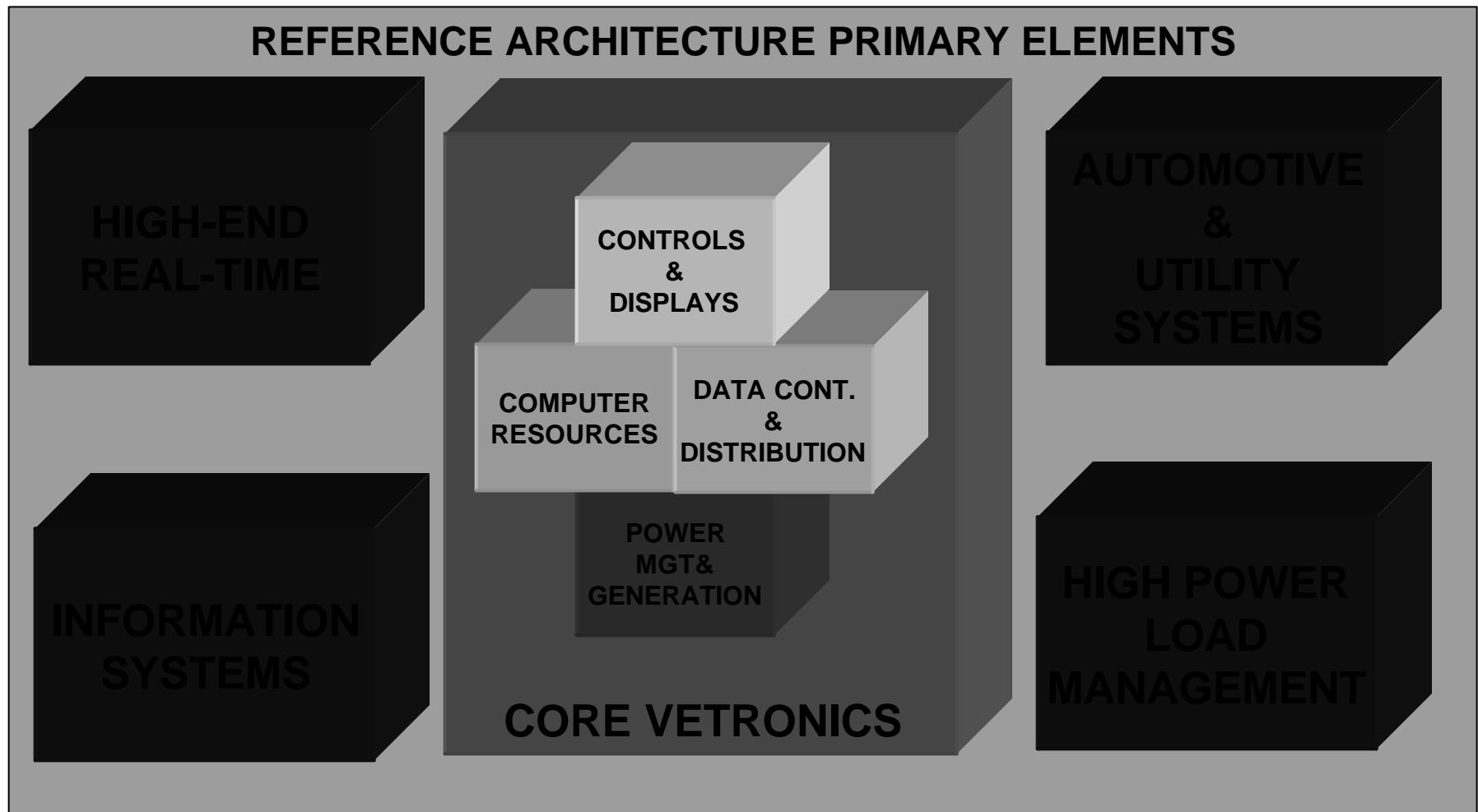
*The Reference Architecture (RA) components are partitioned by engineering discipline*



# System Architecture Elements



- The Army ground vehicle manned/robotic system will be divide into five primary elements:



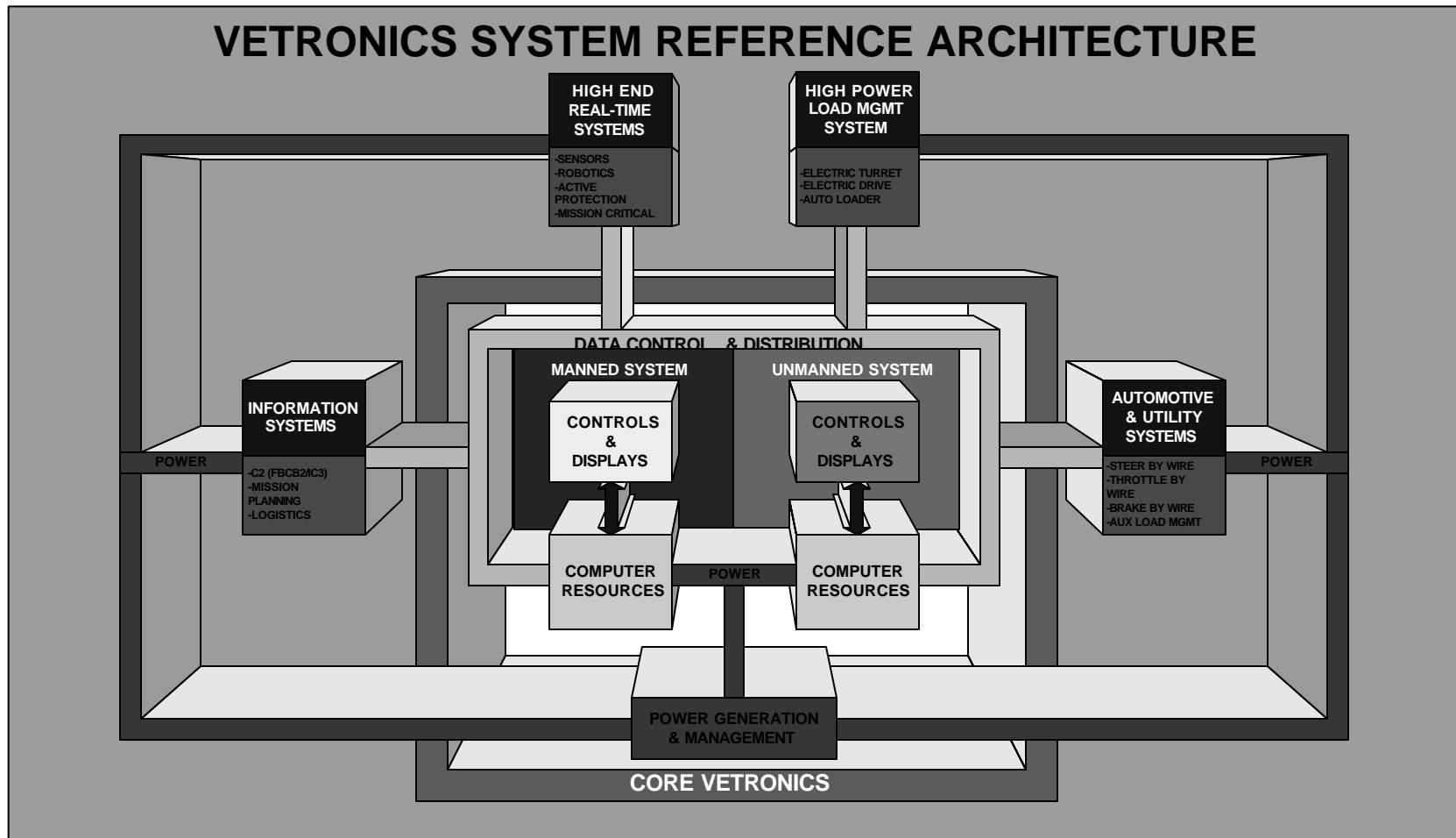
*The Primary Elements provide the bins for leveraged industry & government technologies*



# System Reference Architecture



- The System Reference Architecture defines the abstract organization of the primary elements within the system



*The System Reference Architecture is for both manned and unmanned systems*



# System Reference Architecture Standards



- High Speed Data Bus
- For vehicle applications requiring a high-speed (~1 Gbps) data transfer capability between Core Vetronics and other vehicle systems:
  - ▶ Example Standards – ***ANSI X3.230, Fibre Channel, Physical and Signaling Interface***  
***ANSI X3.272, Fibre Channel, Arbitrated Loop***  
***IETF Standard 6, User Datagram Protocol***

## Test, Debug, and Maintenance Bus

- For digital data communications to processing elements within a vehicle for the purpose of test, debug, and maintenance:
  - ▶ Example Standards – ***IETF Standard 5, Internet Protocol***  
***IETF Standard 7, Transmission Control Protocol***

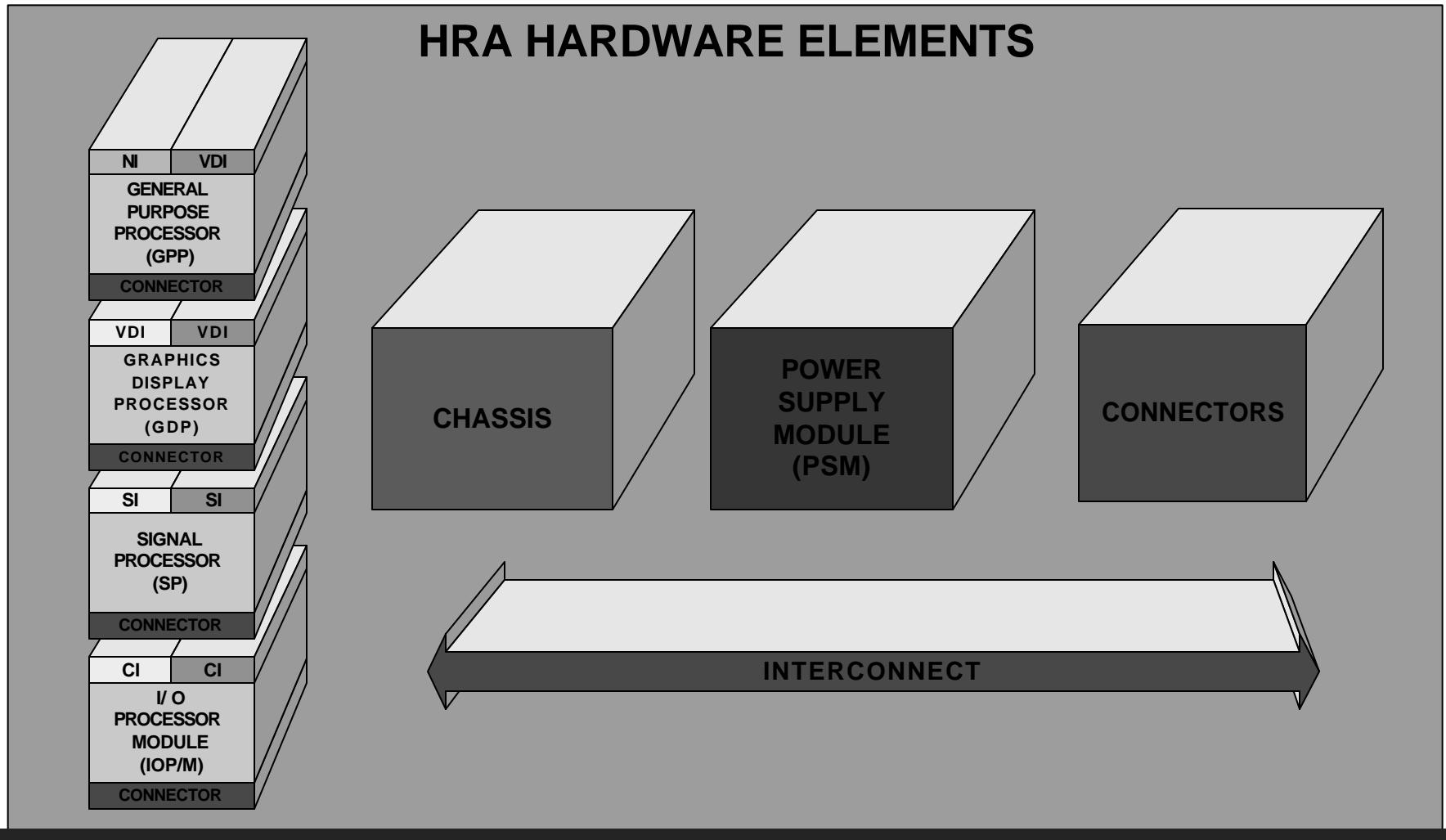
*Complete listing of the standards is in the VRA document*



# Hardware Reference Architecture



- The Hardware Reference Architecture consists of the following user configurable elements:



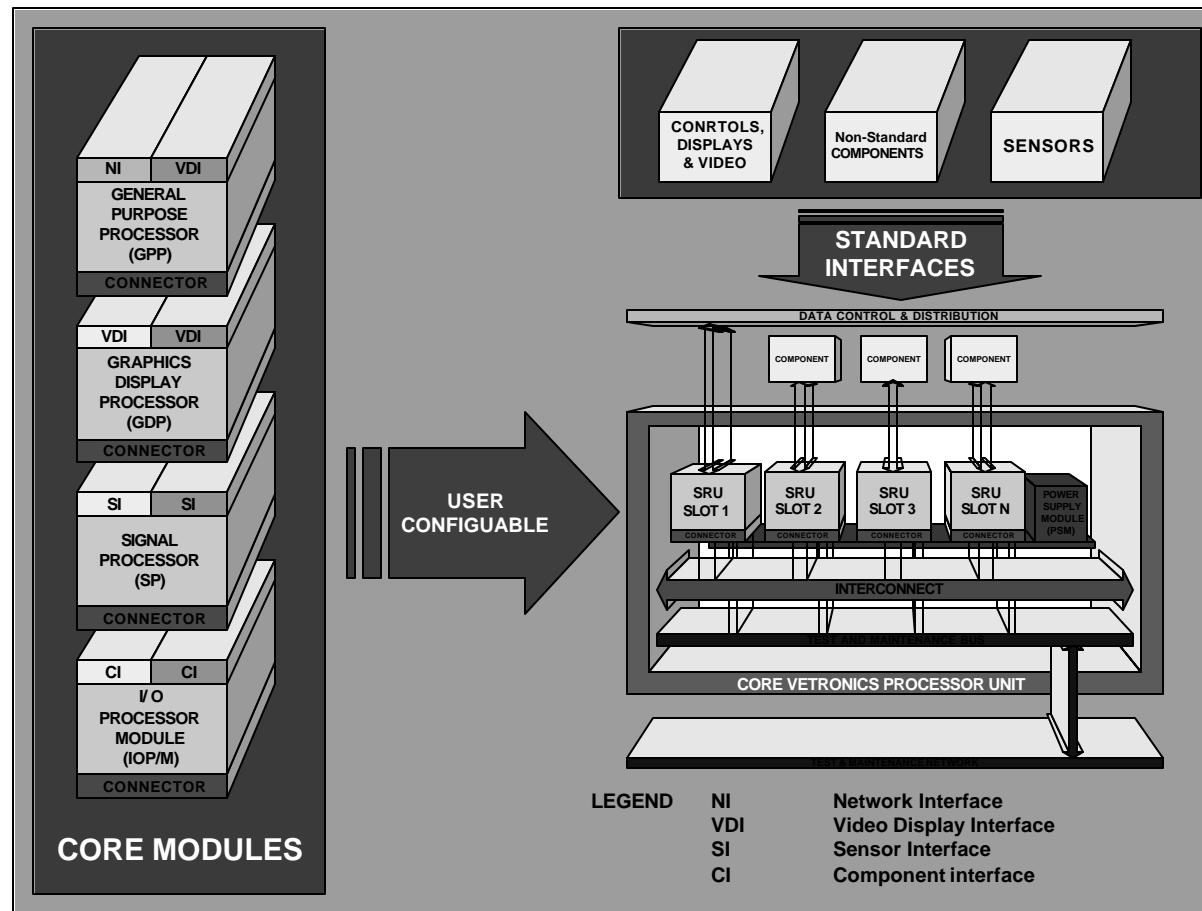
*The HRA hardware is an open, expandable architecture that is scalable to meet application requirements and target unit cost*



## Hardware Reference Architecture Cont.



- The HRA open architecture utilizes and supports the use of industry open standards thus providing a means to promote:
  - Commonality, Reusability and Upgradeability**



*Depending on the crew size, complexity and fault-tolerance requirements of the vehicle one or more physical nodes may be required.*



# Hardware Reference Architecture Standards



- CVPU Chassis consists of a backplane that mechanically accept circuit cards.
  - ▶ ***Utilize conduction cooling as a preferred means of removing heat***
  - ▶ Example Standards –  
**ANSI/VITA 1 (VME64)**  
**IEEE Std 1101.2 (Conduction-Cooled Eurocards)**
- SRU modules accommodate mezzanine plug-on card sites for application tailoring and I/O expansion and custom interfaces
  - ▶ ***Utilize PMC as a preferred interface***
  - ▶ Example Standards –  
**PICMG Version 2.1 Compact PCI (Peripheral Component Interconnect) Specification**  
**IEEE P1386.1 (PCI Mezzanine Cards)**
- Power Supply Module (PSM) - will provide all the necessary power for components in the CVPU.
  - ▶ ***Utilize military standards for vehicle power requirements***
  - ▶ Example Standards -**MIL-STD-1275**  
**MIL-STD-464**

*Complete listing of the standards is in the VRA document*



# Software Reference Architecture Rationale



- Identification, selection, and application of relevant standards/middleware.
- Ensuring mixed software languages, middleware, and development environments work together.
- Selection/integration of relevant next generation technologies while avoiding technology obsolescence.
- Maximization of COTS technologies/products (promote multiple vendor sources/competition to ensure availability of market alternatives).
- Maintaining real time performance while providing protection/isolation to the application software.
- Reduce the amount of time required to develop Vetronics systems
- Keep us on schedule and budget
- Produce re-useable Vetronics hardware and software components
- Increase the level of commonality between vehicles
- Promote the adoption of open systems architecture concepts
- Improve compliance with JTA-Army standards



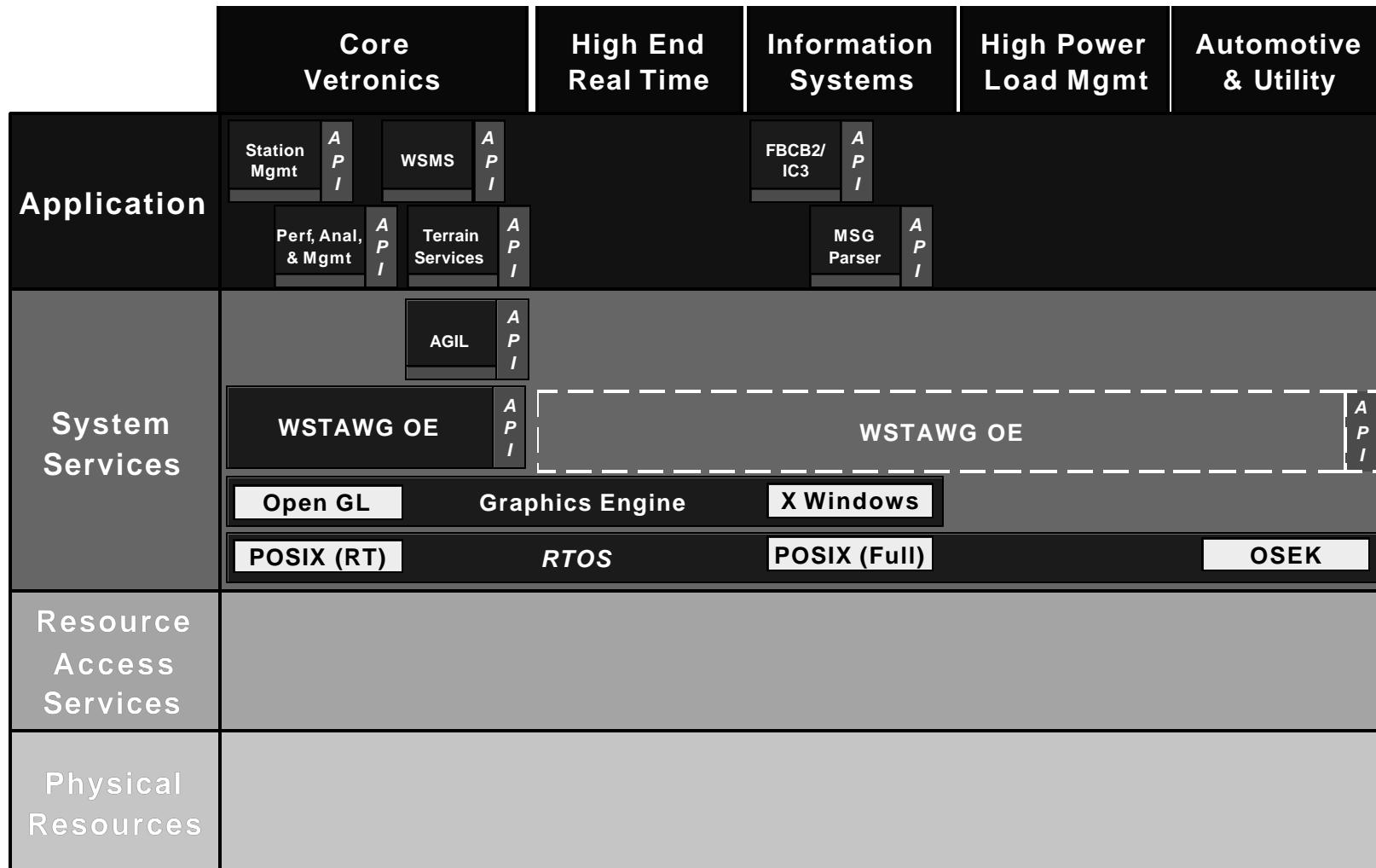
# Software Reference Architecture Goals



- Non proprietary and Open System
- Provide flexibility where possible
- Layered and focused on interfaces
  - ▶ Provide traceability from APIs to defined system requirements.
  - ▶ Design APIs for reuse and interoperability (define physical/logical interfaces).
    - Define APIs/middleware to isolate dependencies, ease porting,
    - Define APIs/middleware to be adaptable in order to map to a variety of implementations.
  - ▶ Define APIs/middleware such that they can be replaced by emerging standards as they mature and are accepted by industry and DoD.
  - ▶ Design APIs for testability (carry through conformance/validation requirements).
- Not locked into specific paradigms (e.g. patterns, languages, methodologies).
- Include industry, academia, and standards bodies to the degree possible when defining new APIs and/or middleware.



# Software Reference Architecture



*Populated from JTA-Army and Iterative TA and Domain Intelligence Modeling.*



- An API/Standards-based architecture concentrates on interface definition by identifying applicable APIs and standards for physical and logical interfaces.
  - ▶ Utilizes SAE GOA model as a clear concise framework to partition capability.
  - ▶ Concentrates on interfaces to achieve interoperability, not products.
- Benefits:
  - ▶ Promotes reuse at multiple layers.
  - ▶ Minimizes application impact from insertion of new technologies.
  - ▶ Facilitates interoperability through the identification of unambiguous interface definitions.
  - ▶ Enables plug and play capability not only at the resource access services layer (hw/drivers), but at the system services and application layers as well.
- Where Utilized:
  - ▶ Commercial/industrial base to facilitate product line engineering.
  - ▶ WSTAWG/JTA-Army



## Summary



- VRA defines a generic system architecture that can serve as a template for the development of new or upgraded Vetronics & Robotic systems
- VRA consists of a system, hardware and software reference architecture
- The VRA
  - ▶ Reduces ground combat vehicle acquisition and support costs
  - ▶ Utilizes Industry Supported Open Standards
  - ▶ Facilitates Upgradability
- The VRA is being used on the Crew-Automation and Integration Testbed/Robotic Follower Advanced Technology Demonstrator

Contact Rakesh Patel, (810) 574-5188 US Army TACOM for copy of VRA